

BIOLOGICAL PLANT SCIENCE

Curriculum Content Framework

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Curriculum Content Framework

BIOLOGICAL PLANT SCIENCES

Grade Level: 10, 11, 12

Course Code:

Prerequisites: Agriculture Science and Technology or Agriculture Science; Plant Science

Course Description: This course is a scientific approach to plant science using scientific principles and applied management practices. An emphasis on selection and industry review will be based on scientific data.

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Unit 1: Biological Science in Our Lives

5 Hours

Terminology: Biological plant science, Career Development Event (CDE), Genetic engineering, Genetically modified organism (GMO), Supervised Agricultural Experience program (SAE)

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
1.1 Define the basic terms associated with biological plant science		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
1.2 Identify ways in which biological sciences affect our everyday lives	1.2.1 Collect magazine and newspaper articles related to the topic	Foundation	Reading	Adjusts reading strategy to purpose and type of reading (skimming and scanning) [1.3.1] Applies information and concepts derived from printed materials [1.3.3] Draws conclusions from what is read [1.3.12]
		Thinking	Creative Thinking	Uses imagination to create something new [4.1.1] Develops visual aids to create audience interest [4.1.4] Makes connections between seemingly unrelated ideas [4.1.6]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
1.3 Analyze misconceptions about biological engineering	1.3.1 Write a science-fiction short story about the potentials of biological plant science	Foundation	Reading	Comprehends written information for main ideas [1.3.7] Distinguishes between fact and opinion [1.3.11] Evaluates written information for accuracy, appropriateness, and style [1.3.14] Identifies inaccurate information/entries on written documents [1.3.15]
		Interpersonal	Cultural Diversity	Recognizes differences among team members [2.2.3] Respects others' personal values, cultures, and traditions [2.2.4]
		Thinking	Reasoning	Determines which conclusions are correct when given a set of facts and a set of conclusions [4.5.3]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
1.4 List career opportunities in the biological sciences	1.4.1 Research a career in the biological sciences to determine educational requirements, working conditions, and salary	Foundation	Writing	Applies rules of grammar, punctuation, capitalization, and spelling [1.6.3] Checks, edits, and revises document for correct information, appropriate emphasis, form, grammar, spelling and punctuation [1.6.5] Evaluates written information for appropriateness/content/clarity [1.6.9]
	1.4.2 Create a current, business style resume	Personal Management	Career Awareness, Development, and Mobility	Develops skills to locate, evaluate, and interpret career information [3.1.4] Explores career opportunities [3.1.6] Identifies continuing changes in male/female roles at home and work [3.1.7] Identifies education and training needed to achieve goals [3.1.8]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
1.5 Discuss FFA opportunities for students interested in biological sciences		Foundation	Listening	Evaluates oral information/presentation [1.2.2] Listens for content [1.2.3] Listens for long-term contexts [1.2.7]
			Speaking	Asks questions to clarify information [1.5.3] Asks questions to obtain information [1.5.4]
		Personal Management	Career Awareness, Development, and Mobility	Analyzes impact of work on individual and family life [3.1.1] Monitors progress toward goal attainment [3.1.10] Sets well-defined and realistic personal/career goals (short-term and long-term) [3.1.11]
1.6 Discuss SAE options dealing with biological plant science	1.6.1 Take a biological plant science field trip associated with new concepts used in industry	Foundation	Science	Analyze environmental issues [1.4.2]

Unit 2: Conducting Experiments

15 Hours

Terminology: Average, Control, Dependent variable, Experimental method, Hypothesis, Independent variable, Mean, Scientific method, Treatment

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
2.1 Define terms associated with experimentation		Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6] Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]
		Thinking	Knowing how to Learn	Develops personal learning strategies—note taking, clustering related items, flash cards, etc. [4.3.2] Locates appropriate learning resources to acquire or improve knowledge and skills [4.3.3]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
2.2 Identify basic scientific equipment and give an example of how each would be used	2.2.1 Conduct an experiment using a microscope, test tube, beaker, balance/digital scales, and Petri dish.	Foundation	Science	Acquires and processes scientific data [1.4.1] Applies knowledge to complete a practical task [1.4.3] Converts quantities and measurements from one form to another [1.4.12] Determines quantities/measurements in English and metric units [1.4.14] Measures dry and liquid supplies [1.4.16] Reads measurements from common measuring devices [1.4.20]
2.3 List steps in conducting experimental research		Foundation Thinking	Science Problem Solving	Applies/Uses scientific method [1.4.7] Describes/explains scientific principles related to research [1.4.14] Comprehends ideas and concepts related to scientific research [4.4.1] Draws conclusions from what is read, and gives practical solutions [4.4.3]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
2.4 Explain how the research process is applied to lab and field experiments	2.4.1 Conduct a simple experiment	Foundation	Science	Applies knowledge to complete a practical task [1.4.3] Applies a scientific principle to solve a problem [1.4.8]
		Interpersonal	Teamwork	Contributes to group with ideas, suggestions, and effort [2.6.2] Works effectively with others to reach a common goal [2.6.6]
		Personal Management	Integrity/Honesty/ Work Ethic	Complies with safety and health rules in a given work environment [3.2.2]

Unit 3: Summarizing and Reporting Research

10 Hours

Terminology: Abstract, Background, Bibliography, Conclusion, Finding, Hypothesis, Procedure, Recommendation

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
3.1 Define terms		Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6]
3.2 Explain the difference between findings, conclusions, and recommendations		Foundation	Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6] Presents answers/conclusions in a clear and understandable form [1.6.13]
		Personal Management	Responsibility	Exhibits enthusiasm in approaching and completing tasks [3.4.3] Sets high standards for self in completion of a task [3.4.9]
3.3 List the major parts of a research paper	3.3.1 Prepare a research paper on the experiment from Unit 2 of the framework	Foundation	Writing	Records data [1.6.16] Summarizes written information [1.6.17] Writes appropriate entries [1.6.22]
		Thinking	Seeing Things in the Mind's Eye	Imagines the flow of work activities from narrative descriptions [4.6.1] Visualizes a finished product [4.6.4]
3.4 Demonstrate the correct use of various charts, graphs, and tables used in scientific experimentation	3.4.1 Construct a chart, graph, or table to illustrate findings from Unit 2 of the framework	Foundation	Science	Constructs graph of data [1.4.9]
			Mathematics	Constructs graphs/charts/tables [1.1.17]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
3.5 Construct a bibliography/ reference page	3.5.1 Create a works-cited page for experiment from Unit 2 of the framework	Foundation	Reading	Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]

Unit 4: Genetics and Heritability

10 Hours

Terminology: Allele, Chromosome, DNA, Dominant gene, F1 hybrid, Gene, Genotype, Heritability, Heterozygous, Homozygous, Hormone, Hybrid vigor (heterosis), Incomplete dominance, Mutation, Phenotype, Punnett Square, Recessive gene

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
4.1 Define terms associated with genetics		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
4.2 Discuss how dominant and recessive genes affect the characteristics of plants		Foundation	Science	Describes/Explains scientific principles related to dominant and recessive genes [1.4.14]
			Speaking	Applies/Uses technical words as appropriate to audience [1.5.2] Participates in conversation, discussion, and group presentations [1.5.8]
		Interpersonal	Coaching	Helps others learn new skills [2.1.3]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
4.3 Illustrate the importance of the various plant breeding schemes	4.3.1 Conduct a research study to determine how cross pollination and selective breeding influence color, size, and fruit and flower quality	Foundation	Reading	Uses appropriate materials and techniques as specified [1.3.20] Uses written resources (books, dictionaries, directories) to obtain factual information [1.3.23]
		Thinking	Knowing how to Learn	Locates appropriate learning resources to acquire or improve knowledge and skills [4.3.3] Processes new information as related to workplace [4.3.5]
4.4 Explain how genetic principles are used to improve agricultural production		Foundation	Listening	Comprehends ideas and concepts related to animal production [1.2.1] Listens for content [1.2.3] Listens to follow directions [1.2.6]
		Thinking	Reasoning	Applies rules and principles to a new situation [4.5.1] Sees relationship between two or more ideas, objects, or situations [4.5.5] Uses logic to draw conclusions from available information [4.5.6]

Unit 5: Plant Processes

10 Hours

Terminology: Gravitropism, Legumes, Nitrogen fixation, Phototropism, Theotropism

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
5.1 Define the terms associated with plant processes		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
5.2 Explain the process of nitrogen fixation in legumes	5.2.1 Germinate beans and examine roots under a microscope	Foundation	Science	Acquires and processes scientific data [1.4.1]
	5.2.2 Identify two legume plants utilized in agriculture	Thinking	Seeing Things in the Mind's Eye	Analyzes environmental issues (ecology, pollution, waste management) [1.4.2] Describes/Explains scientific principles related to nitrogen fixation [1.4.14] Organizes and processes images –symbols, pictures, graphs, objects, etc. [4.6.2] Visualizes a system's operation from schematics [4.6.3]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
5.3 Discuss the purposes and methods of seed inoculation		Foundation	Reading	Applies information to new situations [1.3.5] Applies/Understands technical words that pertain to subject [1.3.6]
		Personal Management	Organizational Effectiveness	Applies knowledge to implement work-related system or practice [3.3.4] Comprehends the organization's modes of operation [3.3.5]

Unit 6: Hydroponic Systems

10 Hours

Terminology: Hydroponics, Nutrient solution

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
6.1 Define the terms associated with hydroponics		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
6.2 Explain how plants are produced hydroponically	6.2.1 Create a hydroponic growing area	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3] Applies information to new situation [1.3.5] Interprets drawings to obtain factual information [1.3.17]
		Interpersonal	Teamwork	Recognizes effects of positive/negative attitudes on co-workers [2.6.4] Works effectively with others to reach a common goal [2.6.6]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
6.3 Identify the advantages and disadvantages of hydroponics		Foundation	Science	Applies scientific principles related to tissue culture [1.4.16] Observes health code/sanitation requirements [1.4.19]
		Thinking	Seeing Things in the Mind's Eye	Organizes and processes images –symbols, pictures, graphs, objects, etc. [4.6.2] Visualizes a finished product [4.6.4]
6.4 Identify the various types of hydroponic systems	6.4.1 Write a paper comparing and contrasting the ebb and flow, nutrient film technique/NFT, media-based system, and aeroponic types of hydroponic systems	Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
6.5 Explain the need/importance of using hydroponics		Foundation	Listening	Comprehends ideas and concepts related to hydroponics [1.2.1]
			Science	Applies scientific principles related to hydroponics [1.4.1]

Unit 7: Plant Tissue Culture

10 Hours

Terminology: Agar, Callus, Explant, Laminar flow hood/Transfer cabinet, Micropropagation, Petri dish

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
7.1 Define terms		Foundation	Reading	Applies/Understands technical words that pertain to subject [1.3.6]
7.2 Explain methods of successful tissue culture		Foundation	Listening	Comprehends ideas and concepts related to tissue culture [1.2.1]
			Science	Applies scientific principles related to tissue culture [1.4.1]
7.3 Identify the advantages and disadvantages of tissue culture		Foundation	Listening	Comprehends ideas and concepts related to tissue culture [1.2.1]
			Science	Applies scientific principles related to tissue culture [1.4.1]
7.4 Discuss the sterile technique		Foundation	Science	Applies knowledge to complete a practical task [1.4.3]
				Applies scientific principles related to sterilization [1.4.4]
				Follows safety guidelines [1.4.15]
				Uses equipment and techniques related to sterilization [1.4.23]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
7.5 Calculate the number of explants potentially produced for a given period of time		Foundation	Mathematics	Applies a mathematical formula to solve a problem [1.1.3] Computes, using a formula [1.1.14] Demonstrates mathematical calculation [1.1.19]
			Science	Monitors variables in experiment [1.4.17]

Unit 8: Biological Engineering

10 Hours

Terminology: Biological engineering, Biotechnology, E. coli, Gene splicing, Particle gun

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
8.1 Define the terms associated with biological engineering		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
8.2 Explain the basic method of gene transfer	8.2.1 Watch the two types of gene transfer used in science applications (particle gun and bacterial insertion)	Foundation	Listening	Comprehends ideas and concepts related to biological engineering [1.2.1]
8.3 Identify the advantages and disadvantages of genetic engineering		Foundation	Listening	Comprehends ideas and concepts related to biological engineering [1.2.1]
			Reading	Applies information and concepts derived from printed materials [1.3.3]
8.4 Discuss concerns associated with genetic engineering			Listening	Comprehends ideas and concepts related to biological engineering [1.2.1]
			Reading	Applies information and concepts derived from printed materials [1.3.3]

Unit 9: Plants and Chemicals

10 Hours

Terminology: Pest, Pesticide

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
9.1 Define the terms associated with plant chemicals		Foundation	Reading	Applies information and concepts derived from printed materials [1.3.3]
9.2 Identify the various types of pesticides	9.2.1 Identify a pest, and apply the proper type of pesticide	Foundation	Listening	Comprehends ideas and concepts related to pesticides [1.2.1]
9.3 Explain various modes of action for pesticides	9.3.1 Observe the effect of different herbicides on plants	Foundation	Science	Constructs hypothesis [1.4.11] Monitors variables in experiment [1.4.18]
		Thinking	Reasoning	Extracts rules or principles from written information [4.5.4] Sees relationship between two or more ideas [4.5.5]

CAREER AND TECHNICAL SKILLS What the Student Should Be Able to Do		ACADEMIC AND WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	Application	Skill Group	Skill	Description
9.4 List and identify the function(s) of common plant hormones and growth regulators	9.4.1 Compare the effects of different growth regulators, including auxins, cytokins, gibberlic acid, and ethylene, on plants	Foundation	Science	Constructs hypothesis [1.4.11] Monitors variables in experiment [1.4.18] Performs experiment as specified [1.4.20] Records measurements from common measuring devices [1.4.21]
		Thinking	Problem Solving	Draws conclusions from observations, evaluates conditions, and gives possible solutions [4.4.5] Tracks and evaluates results [4.4.10]

Glossary

Unit 1: Biological Science in Our Lives

1. Biological plant science—the biological approach to plant science
2. Career Development Event (CDE)—an FFA activity a student may choose to participate in; reinforces what is learned in the classroom and laboratory
3. Genetic engineering—an advanced form of biotechnology; techniques involve gene splicing, replication, and transfer of genes to other organisms
4. Genetically modified organism (GMO)—an organism that has been altered through the use of biotechnology
5. Supervised Agricultural Experience program (SAE)—an activity that a student undertakes to gain real-world experience in agriculture

Unit 2: Conducting Experiments

1. Average—the value arrived at by adding the quantities in a series and dividing that total by their number
2. Control—to hold constant
3. Dependent variable—a variable that is measured to determine the effects of the independent variable
4. Experimental method—a process of scientific inquiry where all factors, except the variable under investigation, are controlled or held constant
5. Hypothesis—a tentatively accepted theory that explains the relationship between two variables
6. Independent variable—the variable in an experiment that is manipulated
7. Mean—midway between two extreme numbers
8. Scientific method—a carefully controlled, systematic process for discovering the unknown
9. Treatment—the manipulation of an independent variable

Unit 3: Summarizing and Reporting Research

1. Abstract—a summary or short version of a piece of writing
2. Background—information that reveals key knowledge about an item or theory that can be used to support ideas or give guidance for further investigation
3. Bibliography—a list of references presented in a manner that the sources can be found again for verification or further studies
4. Conclusion—specific statements about the relationships between variables
5. Finding—actual data generated from an experiment
6. Hypothesis—a tentatively accepted theory that explains the relationship between two variables
7. Procedure—method of carrying out an experiment so it can be replicated again by other individuals
8. Recommendation—a suggestion on how results should be used or for further experimentation

Unit 4: Genetics and Heritability

1. Allele—matching genes on homologous chromosomes
2. Chromosome—that part of a cell that contains information about genetic makeup and transmits that information to offspring; made up of proteins and nucleic acids; consists of DNA
3. Deoxyribonucleic acid (DNA)—a genetic protein-like nucleic acid in plant and animal genes and chromosomes that controls inheritance
4. Dominant gene—causes a certain characteristic to be expressed; present in the offspring
5. F1 hybrid—an offspring of two parents in which the offspring is sterile
6. Gene—the specific determiner of heredity
7. Genotype—the genetic makeup
8. Heritability—the portion of the differences in animals that is transmitted from parent to offspring
9. Heterozygous—having different alleles for a single trait and therefore producing two or more different kinds of gametes
10. Homozygous—having identical alleles at one or more loci and therefore producing identical gametes
11. Hormone—a chemical messenger substance produced in one location of an organism and carried to another where it has a specific effect(s)
12. Hybrid vigor (heterosis)—the act of the offspring outperforming the parents due to gene combination
13. Incomplete dominance—when neither gene is dominant, both genes are expressed (example: red and white cattle produce a roan colored calf)
14. Mutation—an accident of heredity in which an offspring has different characteristics than the genetic code intended
15. Phenotype—the physical appearance of an organism
16. Punnett Square—a common method of predicting the genotypes and phenotypes of offspring using a matrix
17. Recessive gene—the character will be masked if either parent has a dominant gene; will only be expressed if the alleles from both parents are the same (and not dominant)

Unit 5: Plant Processes

1. Gravitropism—plant growth in response to gravity
2. Legumes—plants that have the ability to convert atmospheric nitrogen (N_2) to a form that can be used by plant root systems
3. Nitrogen fixation—the biochemical process of converting atmospheric nitrogen (N_2) to a form that can be used by plants
4. Phototropism—plant growth in response to light
5. Theotropism—plant growth in response to touch

Unit 6: Hydroponic Systems

1. Hydroponics—a method of growing plants in which the nutrients needed by the plant are supplied by a nutrient solution
2. Nutrient solution—water with dissolved nutrient salts

Unit 7: Plant Tissue Culture

1. Agar—a nutrient-rich medium used to culture living organisms
2. Callus—an undifferentiated mass of plant cells that grow from an explant when placed on an artificial medium under sterile conditions
3. Explant—small pieces of plant tissue
4. Laminar flow hood/Transfer cabinet—scientific equipment that provides a positive air flow and prevents any foreign material from contaminating a culture
5. Micropropagation—the creation of plant tissue on a small or microscopic scale
6. Petri dish—circular container with a top used for culturing various organisms

Unit 8: Plants and Chemicals

1. Biological engineering—an advanced form of biotechnology; techniques involve gene splicing, replication, and transfer of genes to other organisms
2. Biotechnology—the management of biological systems for the benefit of humanity
3. E. coli—bacteria that are commonly used to deliver new or altered genetic material into an organism
4. Gene splicing—the process of adding new genetic material within the DNA sequence of an organism
5. Particle gun—a device used to insert new genetic material into an organism

Unit 9: Plants and Chemicals

1. Pest—anything that is unwanted
2. Pesticide—anything that is used to control or eliminate